

MARINE BIOLOGY IN WESTERN AUSTRALIA.

PRESIDENTIAL ADDRESS, 1947

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Read by Mr. J. SHEARER, July 8th, 1947.

INTRODUCTION

Twenty-three years ago, Professor W. J. Dakin, first President of the newly-constituted Royal Society of Western Australia, chose as the title of his anniversary address to members of the Society: "Marine Biology in Western Australia." I make no apology for selecting the same subject since my purpose is, primarily, to review the advances that have been made since 1914.

Introducing his subject, Professor Dakin put two questions: "What is Marine Biology?" and "What is the use of Marine Biology?" and I cannot do better than quote his own words (1916, p. 12) in answering these questions. "Marine Biology," he said, "is the study of the organisms of the sea, both animal and vegetable; their relation to each other, and to the ever-changing conditions of their environment." He went on "To the second question I require to say more. In the first place I plead the study of marine biology simply from the point of view of pure knowledge; from a desire to know and understand the earth and all that exists thereon. It is not generally known, I am afraid, that very many more groups of animals from the lowest to the highest are represented in the sea than on land and in the air. Very many problems of the greatest scientific importance are to be solved by the study of the sea and all that therein is. In fact it has been ably suggested that life originated in the sea, and that the saline constituents of mammalian blood indicate even now the composition of the medium once bathing the bodies of aquatic ancestors."

He made the point that the pursuit of knowledge for its own sake is adequate reason for studying marine biology, a view that would receive the support of the majority of scientists since so many of the great advances of a practical use have arisen from the chance observations of the merely curious scientific investigator; but, as he made clear, this branch of biology is closely tied up with the development of fisheries, which fact should satisfy those members of the community who wish to see science devoted to strictly utilitarian purposes.

Professor Dakin drew attention to the value of research into fisheries. Under this heading is included not only the study of fish (which involves a study of their spawning habits, growth-rate, food, migrations, and methods of capture) but also the study of numerous other organisms which may be of economic importance. These are, for example, mussels, oysters, trochus, and pearl-oysters, among the Mollusca; lobsters, crayfish, crabs, and prawns, among the Crustacea; and, of the lower forms of life, *bêche-de-mer*, sponges, and algae, all of which have an economic value, with possibilities of development on the Australian coast. In addition to the study of fisheries, which are productive, there is the application of marine biology to methods of preservation and efficient running—problems concerned with anti-fouling measures.

ADDITIONS TO THE MARINE FAUNA OF WESTERN AUSTRALIA SINCE 1914.

In proposing to give a summary of the additions to the marine fauna of this State which have been made since 1914, it was intended to provide for each group of the animal kingdom a list of references to all the works which dealt with the marine fauna. Circumstances and the time involved in such an undertaking have made this impracticable and (except for the fishes) the following summary refers only to such papers as have been published in the Journal of this Society. It cannot, therefore, be in any way complete, but must be regarded only as an indication of the work which has been done during the last twenty-odd years. A list of the publications referred to in this account will be found at the end, and reference to these papers will disclose additional works published elsewhere which have reference to our fauna. For the fishes a bibliography has been prepared which, it is hoped, more or less fulfils the original intention. This has been compiled from the entries in the Zoological Record.

PROTOZOA

Little work has been done on this phylum, of which the best-known marine representatives are the Foraminifera. In a paper by Chapman and Parr (1935) dealing with a series of bottom samples taken from soundings in the Bight by the trawler "Bonthorpe," 112 species were identified, one of which was new to science. It is difficult to discover how many of these comprise new recordings for this State.

PLATYHELMINTHES

Two workers have published accounts of parasitic forms. Goss (1941) described two new species of Trematodes and two new species of Cestodes, from local shags; and Sandars (1945) described five new species of Trematodes taken from the gills of some local fishes.

ACANTHOCEPHALA

A new species belonging to this group was described by Goss (1941) as a parasite in a shag.

ARTHROPODA

Crustacea. Ten species of Ostracods were identified by Chapman and Parr (1935) from soundings taken in the Bight.

The Copepods have been studied by three workers. Two new species of planktonic forms were described by Fairbridge (1944); two new bottom-living forms from the estuary of the Swan River were added by Thomson (1946); and the present writer (1943, 1945a, b, c) identified a number of marine forms occurring on our coasts, and added seven new species.

Thomson (1946) also described a new Amphipod, and two new Isopods from the Swan River Estuary, and an Isopod was added to the fauna by Glauert (1922).

Among the Decapods, the chief contribution was made by Balss (1935) in his account of the crabs collected by the Hamburg Museum Expedition. He referred to sixty species from this coast, two of which

Marine biological research of purely academic interest has not been undertaken in this State, since it depends on the facilities of a suitably equipped marine biological laboratory, where animals can be kept alive for observation and experiment. It is probable that the establishment of such a laboratory by the Council for Scientific and Industrial Research may fill this need within a few years.

The study of fisheries, on the other hand, although it can be greatly aided by the use of a marine laboratory, depends more directly on work done in the field. The C.S. and I.R. have initiated such work in this State, which has been in progress for several years now, and further reference will be made to it below.

In the absence of such facilities the only work of a marine nature that can be done is the identifying and recording of marine animals, and that work, which belongs to the field of systematic rather than to marine biology, has been carried on for many years by individuals interested in one or other of the many marine groups of the animal kingdom. This work plays an important part in laying the foundations for field work on fishery projects.

The work of recording our fauna may be said to have been started by the first navigators who visited our shores, especially when they were accompanied by naturalists. The record of their work, often published in such a way as to make it difficult of access, has been brought together by Mr. W. B. Alexander who was at one time on the staff of the Museum, and who was a member of this Society in its early days. He published a "History of Zoology in Western Australia" in a series of three papers which appeared in the *Journal of the Natural History and Science Society of Western Australia* (1914) and in the *Journal of the Royal Society of Western Australia* (1916, 1918). This account covers the period from the discovery of Australia up to 1840.

The early voyages were primarily exploratory, and it was not until the arrival of the Expedition from Hamburg Museum, to which Professor Dakin referred in his address, that a systematic account of the fauna of this State was undertaken. The published results of the work of this Expedition constitute a valuable contribution to our knowledge of the marine fauna of this State (*Die Fauna Südwest-Australiens*, 5 vols., 1907-1930, Jena). Of the nineteen phyla of the animal kingdom, almost all of which have marine representatives, nearly one half are reported on in this publication. In spite of this aid, there yet remains a tremendous field to be covered, for the study of which we must rely largely on our own efforts. Much time must therefore elapse before we have any thorough knowledge of our marine life, yet it is one which may well repay an intensive effort since practically all the collecting hitherto has been inshore, while the deeper offshore waters are untouched.

The recent proposal to set up a Biological Survey of Australia is a step in the right direction, and, while it is likely that the chief endeavour of such a Survey would, at first, be directed towards describing and recording the mammals and birds, it is to be hoped that all forms of animal life, marine as well as terrestrial, may eventually be included.

were described as new, and twenty-seven of which were recorded from this State for the first time. Montgomery (1921) had earlier contributed to our knowledge of the Hymenosomid crabs from the Swan River Estuary. Decapods collected by the trawler "Bonthorpe" were identified by Serventy (1937) who also (1938) added to our knowledge of the taxonomic features of the local estuarine shrimp.

Alexander (1916a, b) recorded eight species of Stomatopods known from our coast; and Glauert (1924) added another as well as recording the presence of several Decapods and what was probably a new Isopod.

Arachnida. The peculiar Arthropodan forms known as Pycnogonids were studied by Williams (1939) who described three new forms.

MOLLUSCA

In a "preliminary index" to the Molluscs of this State, Hedley (1916) listed between eight and nine hundred species, and stated that "this number will be increased perhaps fourfold when small species and those from deep water are collected." It has not been ascertained what proportion of these are marine, nor which were new to our fauna.

This group has not received very much attention since Hedley's paper was published, except for the primitive forms belonging to the Amphineura, also known as Chitons. In a series of papers, Ashby (1921, 1922, 1924, 1929), and Ashby and Cotton (1934), recorded the presence of four species hitherto unrecorded for this State, and added nine new forms to our fauna list. Cotton (1935) described a new species of Patelid Gastropod, and (1929) added five new species of Cephalopod molluscs.

BRACHIOPODA

In this interesting group of animals with bivalve shells, superficially resembling molluscs, Glauert (1922) recorded the presence of *Lingula* on our north-west coast.

ECHINODERMATA

The only contribution under this heading was the identification by Bennett of species collected by Dr. Serventy when on a trawling cruise in the Bight (1937).

PISCES

A new species of fish was described by Alexander (1917) which was related to a genus previously known only from Havana and Mauritius. Glauert (1921) identified a collection of fish made by the trawler "Penguin" off Albany, comprising twenty-five different species, several of which were recorded from our coasts for the first time. The same author (1922) added another species as a new record; and another new species was described by Serventy (1937) from the Bight.

Many of the papers dealing with our fish fauna, as with most other groups, have been published in journals other than that of this Society. A separate bibliography for the fishes is given below, which includes those contributions referred to in this section.

AVES

Although it may be a question of opinion as to whether sea birds visiting our shores should rightly be included in our marine fauna, I cannot omit drawing attention to the contributions made to our knowledge of this group in a series of papers by Glauert (1921, 1922, 1929, 1938, 1943).

Summarising this brief and, unfortunately, incomplete account of the additions to our marine fauna during the past 23 years, it appears that approximately 100 new forms have been added, half of them within the Crustacea. For reasons given above, this figure does not take into account Hedley's work on the molluscs. To anyone familiar with the classification of the animal kingdom it will immediately be apparent that only a very small proportion of the groups have been studied, but once again it should be stressed that this does not take into account works published elsewhere than in the Journal of this Society.

FISHERIES RESEARCH IN WESTERN AUSTRALIA.

In 1914, when Professor Dakin referred to the practical use of marine biology in the development of fisheries, little was known of the capacity of the seas off our coast to support a full-scale fishery. In the succeeding years the casual methods of fishing employed by various individual fishermen were continued and little, if any, research was done to discover the extent of our fishery resources, or to organise the fishery to the best advantage of the community.

Before the C.S. and I.R. formed the Division of Fisheries, most of the commercial fishing in this State was carried out by small craft, equipped only with very simple gear, and worked by small crews in estuaries and inlets, from beaches, or close inshore. In addition to this there was the truly marine fishery for snapper and jewfish, using hook and line, which operated from the three ports, Geraldton, Fremantle, and Bunbury. This fishery extended to north of Shark Bay. Trawling grounds were known to exist in the Bight, and off the north-west coast, but the Bight grounds were not being worked, while the other was known only from reports which filtered through from Japanese sources, since it had been discovered and worked by Japanese crews who took their catches to Singapore. There were indications that these might be rich grounds.

The formation of the Fisheries Division provided not only the stimulus but also the means of carrying out organised research into fishery problems. The work of the Division in its early years was directed towards surveying and developing fishery resources with special reference to the pelagic or surface fisheries, since the Commonwealth Government had earlier undertaken fairly extensive investigations into the demersal or bottom fisheries, under the direction of H. C. Dannevig, in the "Endeavour." From his work something had been learned of the Bight grounds.

The chief fishery resources of this State are primarily, of course, fish; but in addition there are valuable potential fisheries for crayfish, whales, turtles, edible and pearl oysters, sharks (for the liver oils), possibly sponges, and for those sea-weeds which yield agar-agar.

Fisheries based on bottom-living fish inhabiting clearly-defined grounds do not present any great problem. Once the grounds have been located, and provided they are of sufficient extent to support an established fishery, the problem is one of rational exploitation. Such fisheries, by virtue of their nature, require strongly-built, sea-going vessels, equipped with heavy gear and a sufficient crew. These factors all contribute to a high initial expense and relatively high running costs, so that to be a success financially, reliable supplies of fish are essential.

In the case of fish which live at or near the surface, and roam the seas in their search for food—the pelagic fish—the problem of continued supplies is much more serious, although the lower capital outlay and running costs compensate for this disadvantage to a certain extent. In the case of the European herring, which is a pelagic fish, continuity of supplies is more or less assured owing to the knowledge of their habits which fishermen have gained from generations of experience. Even in this case, supplies are not always assured, and fishermen may return to port with poor catches, so that research into the factors which control the migrations of herring has been going on for many years. Attempts have been made in Europe and in the United States to employ aircraft for spotting shoals of fish, particularly the herring, and these efforts have met with varying amounts of success. Similar work has been undertaken in Australia by the C.S. and I.R. Towards the end of 1942 work began in this State by an observer accompanying coastal patrols from which were derived much useful information, supported by aerial photographs. Later, identification of the fish composing some of the large shoals was confirmed by employing a fishing vessel to work in co-operation with aerial spotting.

The results of this survey in Western Australia, during which nearly the whole of the coast-line of the State was covered on several occasions at different seasons, enabled the observer to report the presence of large shoals of pelagic fish in local waters. It would seem, therefore, that aerial spotting of fish shoals should be a practical method of locating pelagic fish, resulting in a considerable saving of time normally spent in searching by boat. Much work, however, remains to be done to discover the best method of catching such fish once they have been located, and future research by officers of the Division may be along these lines. It is to be hoped that their efforts will meet with every success and that the fishing industry in this State will be put on a sound commercial basis.

There are, however, other fisheries of commercial value to the State, and one of these is concerned with the mullet (*Mugil dobula*). This fish spends part of its life in the sea, and part in river estuaries. It is not restricted to the west coast but occurs in the east, and this species has been the subject of research during the past few years. Much remains to be discovered about the habits of this fish, and as part of the endeavour to learn more about its migrations, an extensive programme of tagging has been undertaken.

Similar work has been done on the Perth Herring (*Nematolosa come*), and research has also been undertaken on the Australian salmon (*Arripis trutta*), more particularly in relation to its suitability for canning, since it is not highly regarded in its fresh state but yields a very attractive canned product.

The life-history, habits, distribution, and marketing of the marine crayfish are also being investigated. There are several species of this crustacean known to this State, one belonging to the genus *Jasus*, the others to the genus *Panulirus*. The Southern Commercial Crayfish (*J. lalandii*) is to be found from Cape Naturaliste south to the Leeuwin, and thence eastwards at least as far as Esperance. It is also found on the south-eastern coast of Australia, and in South Africa and New Zealand, in all of which places it is marketed though as yet there is no fishery for it on a commercial basis in this State.

The Western Australian Commercial Crayfish (*Panulirus longipes*) occurs from Cape Leeuwin northwards to Vlaming Head on North-West Cape, and possibly further north. Three other species of this genus are known to occur on the north-west coast, and appear to be associated with coral reefs or muddy grounds. The coast-line in the range of *P. longipes* has a very extensive series of reefs which harbour the crayfish, but commercial working over much of the ground is rendered difficult owing to the lack of harbours and roads so that this ground is virtually unfishable under existing conditions and may constitute a natural sanctuary which could contribute to the stock of the commercial grounds by means of larval distribution.

In conjunction with this work, hydrological investigations and studies of the plankton are being carried out, while the related question of the study of ocean currents is also being watched. From the evidence of drift-bottles there are reasons for believing that the set of currents along the west coast is not quite as simple as has been thought. This work should prove of great value in the future, since the movements and distribution of the drifting food of fish, and of the young stages of fish and crayfish, are largely governed by movements of the water. At present, however, drift-bottle work is limited to the surface.

Botanical work in this State has been undertaken on the larger algae, particularly in connection with the search for an alternative source for agar-agar, most of the world supplies of which used to come from Japan. Two suitable algae occur on our coast, *Gracilaria* and *Eucheuma*, and of these the former yields the higher grade product for bacteriological work. Unfortunately, the variety of that algae occurring here has a lower yield of agar than the similar form in the Eastern States. Only *Eucheuma* is of commercial value here, and, although it yields a product unsuitable for bacteriological purposes, it is excellent for many industrial needs.

The Natural Science Departments of the University have co-operated to some extent in the exploratory work carried out by the Division of Fisheries, and are of course undertaking research of more academic interest such as ecological surveys and the study of the seasonal succession of marine algae on shore reefs. Studies of shore ecology on the south-west coast of this State are rendered difficult by the absence of regular and predictable tides (Curlewis, 1916).

Having undertaken this attempt to bring up-to-date an account of Marine Biology in this State, it is appropriate to take stock of what has been accomplished during the past twenty-three years.

Useful academic work has been done by those who have contributed

to our knowledge of the systematics and ecology of our fauna and flora, but in these fields much remains to be done.

On the economic side, research is getting into its stride, and while much has been accomplished there is still much to be done. Co-operation between State and Commonwealth organisations in fisheries research has been whole-hearted throughout, and it is only by such co-operation that the best results will be achieved in the shortest time.

In concluding this account I would express the hope, which I am confident will be more than fulfilled, that the next quarter-century of research in marine biology in this State will yield even greater results, and that this branch of science will play its full part in the development of our natural resources.

ACKNOWLEDGMENTS

I am grateful to Dr. D. L. Serventy for making available much of the information from which this account of fisheries research in this State has been prepared, and to Mr. K. Sheard for similar help regarding the work on marine crayfish.

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